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Automatic Anesthesia Balancer Device Using Advanced Technology

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ABSTRACT
Conceptual Monitoring of high/low portion of sedation during medical procedure may cause a deadly impact on the patient. To conquer such an impact on the patient, the anesthetist manages not many milliliters of sedation at customary spans. Sedation mixture might be a control framework, inside which anesthesiologists follow the strategy for foreseeing and applying the foreseen portion. to deal with a proper portion one should consistently screen diverse physiological boundaries. this can be a difficult work. Numerous specialists are attempted to encourage the response to the current issue. Sedation acceptance is identified with successive crucial sign variance like hypotension and hypertension. On the off chance that it's conceivable to precisely foresee pressure level a few minutes ahead, anesthesiologists can proactively give sedative administration before patients build up a hemodynamic issue. The objective of this paper is to build up a programmed Anesthesia regularization framework.

***Keywords* -** Anesthesia, microcontroller, monitoring, sensors.

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I. INTRODUCTION

Anesthesia means sensation loss. During a procedure, anesthesia prevents the sensations of pain and other unpleasant feelings. Significant medical procedures are performed to get rid of or renovate the disease-ridden parts inside the patient. These medical procedures will bring about loss of blood and agony. As a result, it's critical to stop the pain and loss of blood. Anesthesia is an important component of pain relief. Before each clinical procedure, the patient must be anesthetized by specialists to begin their surgery. On the off chance that the medical procedure goes on for an extended period, say for assume 4 to 6 hours, an entire dose of Anesthesia shouldn't be run in a single stroke, it will result in the patient's death. Right now, in medical procedures, an anesthetist makes use of a manual arrangement where the patient has been given an anesthetic. This could begin with numerous complications like a portion of Sedation is becoming more diversified, with the possibility of unpleasant outcomes in the future. Besides, the anesthetists might neglect to deliver the precise portion of sedation for a pre-determined time which could be disturbed the patient during the surgical activity. And sedative cycles should be repeating and require the anesthetist's full attention were usually human's blunders. The occurrence of blunders is diminished in light of the automated mechanism of drug administration.

To defeat such unsafe issues the arranging of an automatic anesthesia regularization machine upheld by an Arduino with an inbuilt micro-controller has been used effectively. Sedation is incredibly fundamental in doing an easy medical procedure then an Automatic supply of sedation is helpful for a fruitful medical procedure. Anesthesia is that the term applied to the medications need to deliver sedation. There are a few anesthetic agents accessible. There are two kinds of anesthetics: -

- Intravenous Anesthetics –A needle is used to inject anesthetic into the patient's body
- Inhalation Anesthetics – sedative which is inhaled by the patient.

It can support controlling your breathing, bloodstream, and vital sign. Not every sort of Anesthesia can make a patient unconscious. It might be used on various parts of the body. Anesthesia is also wont to relax you, to dam agony, and cause you excessively sluggish or forgetful. Anesthesia comes in a variety of forms. Anesthesia is primarily divided into three categories. They are as follows:

- General anesthesia.
- Regional anesthesia.
- Local anesthesia.

Different sorts of research works are done and as yet happening related with the Automated Anesthesia Regularization System. Some are listed below:

Automated Drug Delivery in Anesthesia by Martine M[1]. Neckebroek[2], Tom De Smet[3], Michel M. R. F. Struys[4]: Automated drug administration by the closed-loop system has been proposed to upgrade drug administration during anesthesia. This depicts the new improvement in automated drug conveyance frameworks material during sedation, anesthesia, and postoperative relief from discomfort. [1]

Low-Cost Anesthesia Injector supported Arm Processor by N. Manikandan[1], S. Muruganand[2], K. Vasudevan[3]: The Arm processor reads the signal from the heartbeat sensor and temperature sensor, and its relating change in heartbeat and temperature of the patient the anesthesia is to incline. By utilizing different electrical circuits, the bio-medical parameters will be found. The circuits' yield is increased by using an amplifier and feeding it through an A/D converter. [2]

Using a Heart Beat Sensor to regularize anesthesia during surgery by Sushma Chowdary Polavarapu[1], Kranthi Madala[2], Sri Hari Nallamala[3] and Anesthesia Regulation using Different Sensors by Prof. S.M.Turkane[1], Waditake Dipali B[2], Gite Punam E[3], Shinde Akshay N[4], and Automatic Anesthesia Regularization System (AARS) with patient observing modules by S. Krishnakumar[1], J. Bethanney Janney[2], W. Antony Josephine Snowfy[3], S. Joshin Sharon[4], S. Vinodh Kumar[5] and Microcontroller-based Anesthesia Injector by Sudha Manogna[1], Valluru Mallishwari[2], Venkat Reddy T[3], Vijaykumar M[4], K Durga Prasad[5]: All of those ventures points to style a proficient microcontroller-based naturally worked anesthesia machine. The sedation level is constrained by many assignment remarks and a microprocessor framework in the suggested Programmed Anesthesia Regularization System, which is supported by the patient's state. To administer anesthetic to the patient, a mechanical syringe infusion pump is used. The anesthetist can control the dose of anesthetic down to milliliters per hour by changing the setting in the keypad. The micro-controller receives the analog input from the keypad, which is used to calculate the optimal amount of anesthetic to feed into the DC motor that controls the infusion pump. [3-6]

Low-Cost Anesthesia Injector supported ATMEGA 32" by D. Sathishmuthu Kumar[1], B. Annadurai[2], J. Abdul Aziz Khan[3] and Microcontroller based Anesthesia Injector by Smt. Leela Salim[1], Abey Thomas[2], Akshay M[3], Athul K Alias[4], MuhammedIrshad E K[5]: In this system, a micro-controller and mechanical syringe infusion pump are provided. The anesthesiologist can choose the dose of anesthesia as far as milliliters each hour to direct sedation to the patient with the help of different sensor results. In the wake of getting the output from the sensors, the micro-controller controls the sign to the necessary level then sent into the dc motor to turn the infusion pump on. The anesthesia is run to the patient in step with the dc motor rotation. [7,8]

Anesthesia system with multi-sensor using Arduino by Gokilavani R[1], Gokulapriya M[2], Jasmine Christy A.R[3], Jeeva R[4] and Study of Automatic Anesthesia Controller by Ishwari Ingale[1], Akanksha Pusatkar[2], Snehal Yeola[3] : Automatic Regularization of anesthesia system regulates medicine infusion based on the health of the patient. Temperature, heartbeat, and SPO2 sensors monitor temperature, heartbeat, and oxygen level separately and provide a signal conditioning circuit with corresponding analog values. [9,10]

Deep Learning-based pressure prediction after anesthesia induction: A Feasibility Study by Young Seob Jeong[1], Ah Reum Kang[2], Woohyun Jung[3], So Jeong Lee[4], Seunghyeon Lee[5], Misoon Lee[6], Yang Hoon Chung[7], Bon Sung Koo[8], and Sang Hyun Kim[9]: The goal of this examination is to foster an ongoing version for anticipating a three-min-in advance stress level from the beginning of anesthesia induction to the section. During this investigation, they arranged and pre-handled the fundamental signs, style a repetitive neural system for the constant expectation of blood pressure in the future. [11]

II. PROPOSED SYSTEM

Embedded systems are now used in a variety of applications in the medical field to control various biomedical parameters. Arduino-based automatic anesthesia is a machine in this design, and it is controlled by various biomedical factors such as temperature, heartbeat, blood oxygen content, and so on. The anesthesiologist can control the amount of anesthetic given to the patient down to milliliters per twenty minutes. The Arduino microcontroller provides the framework for regulating anesthesia to the desired level. The stepper motor's rotation direction is then determined by analyzing several bio-medical characteristics obtained from the sensors.

The stepper motor converts rotational motion into translatory motion when the patient's condition is normal, and the anesthetic in the syringe is administered into the patient's body. If the amount of anesthesia is reduced below the predetermined value, the alert sounds to remind the anesthetist that he or she needs to refill the anesthetic in the needle before continuing with the interaction. Estimation of biomedical parameters is a crucial procedure. These variables determine the patient's natural condition. It has a major impact on the anesthetic dose that must be supplied to the patient. The movement of the stepper motor is solely determined by these parameters. If these bio-medical parameters are outside of the normal range, it is regarded abnormal, and a buzzer will sound to alert the doctor, and the process will only resume once everything has returned to normal.

Considering all the vital parameters during an operation the ranges are tabulated below:

Table I. Bio-medical Parameters Range.

Parameters	**Range**
Blood oxygen level (SpO2)	95% - 100%
Heart rate (BPM)	40 - 140
Temperature	32°C - 37°C

All of the patient's bio-medical characteristics, such as oxygen content in the blood (SPO2), heart rate (BPM), and temperature (°C), will be presented on the TFT LCD with normal or abnormal status. If the display is normal, the microcontroller will send a signal to the motor driver, causing the stepper motor to rotate in predetermined steps, causing the syringe infusion pump to advance. When the liquid in the syringe runs out, the stepper motor reverses direction to return the syringe carrier to its original position, and a message stating "refill anesthesia liquid" is shown on the TFT LCD to alert the person in charge to refill the syringe with anesthetic medicine. The sensors will detect all of these bio-medical factors once for every 30 seconds.

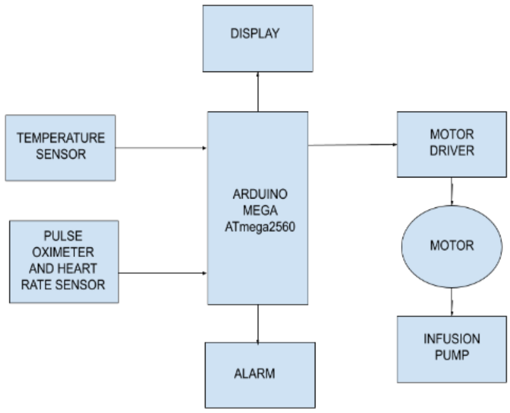

Fig. 1. Block diagram.

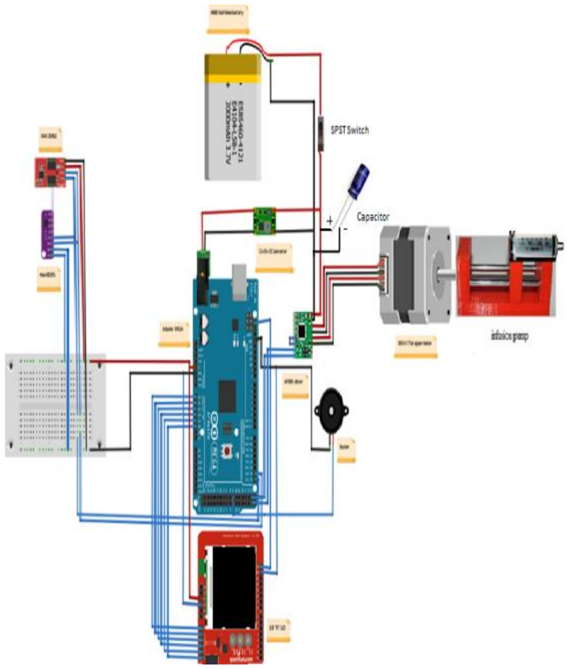

Fig. 2. Circuit Diagram.

2.1 ARDUINO MEGA 2560

Arduino Mega is a microcontroller that works on ATMega 2560 microcontroller. As shown in fig. 3, it has 54 digital input/output pins, in these 16 pins are used for analog inputs and 15 pins are used as PWM outputs in which 4 pins act as UARTs, and it has a 16MHz crystal oscillator and is also equipped with a power jack, ICSP header, USB connector, and a RESET button. This board predominantly incorporates all the items which are fundamental for maintaining a microcontroller. By using a battery, an AC-DC adapter or a USB link from the PC, the power supply to the board can be associated. The SDA and SCL pins of Arduino mega allow I2C interface between Arduino mega and the sensors connected to it these pins located near the AREF pins. We can easily program the Arduino with the help of Arduino IDE. The Arduino IDE is a free software program that lets users write and upload code in a centralized environment. This acts as a main controlling part of the proposed method. It will receive the data from sensor and compare it with predefined values and give the output to the motor driver.

Fig. 3. Arduino-Mega 2560-Board.

2.2 MAX30205 HUMAN BODY TEMPERATURE SENSOR

The MAX30205 temperature sensor monitors temperature precisely and generates an overtemperature caution/interrupt/closure output. It is shown in fig. 4. Using a high-resolution sigma-delta analog to digital converter, this device converts temperature estimates to a computerized structure (ADC). The sensor is suited for wearable wellness and clinical applications since it offers a 2.7V to 3.3V deliver voltage range, a low 600µA supply current, and a lockup-ensured I2C-compatible interface. This device comes in an 8-pin TDFN package and operates in the temperature range of 0 to 50 degrees Celsius.

Fig. 4. MAX30205 Human Body Temperature Sensor.

2.3 MAX30102 PULSE OXIMETER AND HEART-RATE SENSOR

The MAX30102 is pulse oximetry and heartbeat monitor module that works together. It has internal LEDs, photodetectors, optical components, and low-noise devices, as well as a mild dismissing system as shown in the fig. 5. The MAX30102 is a full framework solution for easing the plan-to-measure process for flexible and wearable devices. The MAX30102 is powered by a single 1.8V supply and a separate 3.3V supply for the interior LEDs. A widely used standard I2C-compatible interface is used for communication. The module can be turned off by configuring it with zero reserve current, allowing the power rails to be consistently controlled.

Fig. 5. MAX30102 Pulse Oximeter and Heart Rate Monitor Sensor.

2.4 STEPPER MOTOR AND DRIVER - A4988

The A4988 Stepper Motor Driver as shown in fig.6 is a complete micro exploring motor driver with an integrated converter that is easy to use. It operates between 8 and 35 volts and may deliver up to 1 amp per stage without the use of a heat sink or a limited wind stream. Motor driver is used to isolate the motor and micro-controller because of the power levels which they both operate.

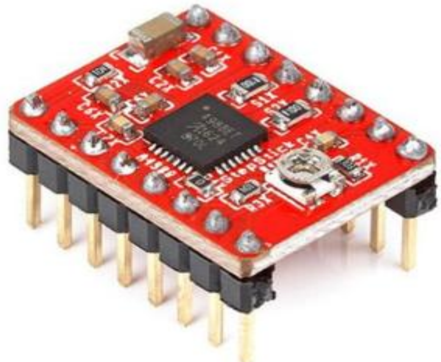

Fig. 6. A4988 Stepper Motor Driver.

Stepper motor as shown in fig.7 is a brushless DC motor with many pivot points. This is particularly useful because it is frequently seen with no input sensor, addressing an open-circle controller. The AAI framework's stepper motor is a NEMA 17 stepper motor. The NEMA 17 is a 1.8° step-angle hybrid stepping motor with 200 stages/revulsion. Taking into account a holding force of 3.2 kg-cm, each stage draws 1.2 A at 4 V.

Fig. 7. NEMA 17 Stepper Motor.

2.5 SYRINGE INFUSION PUMP

By unambiguously moving the plunger of a needle towards its barrel, the syringe infusion pump ensures a consistent flow of fluids as shown in fig. 8. In basic clinical consideration, it provides a precise and consistent stream rate for clearly conveying anesthetic medication. Plastic and glass needles ranging in size from 1ml to 20ml can be handled by this infusion pump. Because it accepts different needle sizes as well, a significantly lower stream rate can be obtained by using a smaller syringe.

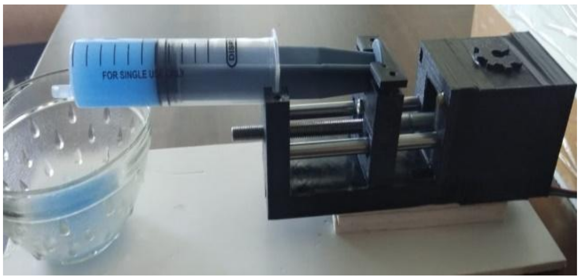

Fig. 8. Syringe Infusion Pump.

III. PROGRAM FLOW

The fig.9 shows and describes the work flow i.e., how a inputs is taken and processed to the final output based on varied parameters. It gives us clear idea about how the internal configuration would work.

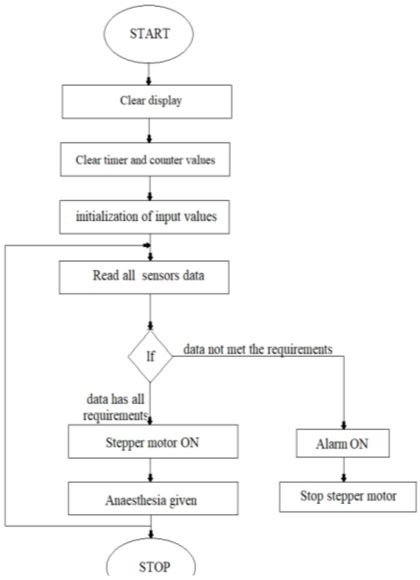

Fig. 9. Flow chart.

IV. RESULTS

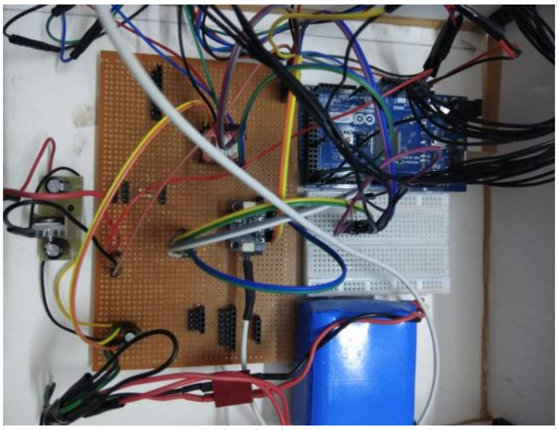

Fig. 10. Connections of The Proposed Model.

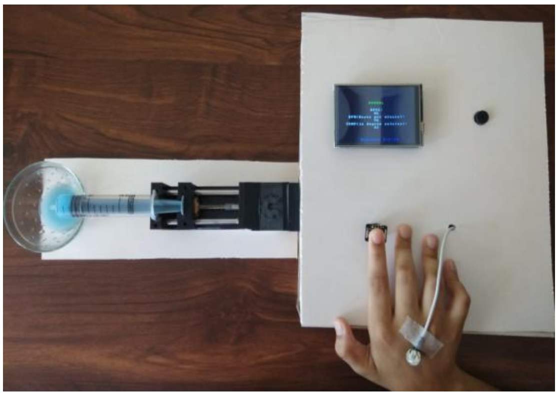

Fig. 11. Final Housing of The Model.

The final housing and connections of the model are shown in above figures. Any values fall in a given range as shown before in Table 1 is considered as Normal conditions and all other values are considered as Abnormal condition in our project. Based on these values, predefined amount of anesthesia will be administered to the patient. If there is any abnormal condition a buzzer will be triggered to alert the doctor, and the process will only resume once everything has returned to normal. The below two figures depict the normal and abnormal conditions of the patient.

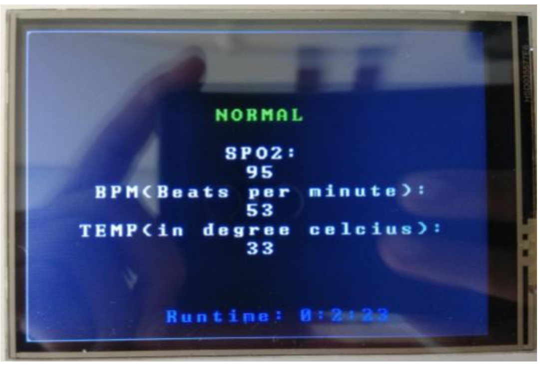

Fig. 12. Under Normal Conditions.

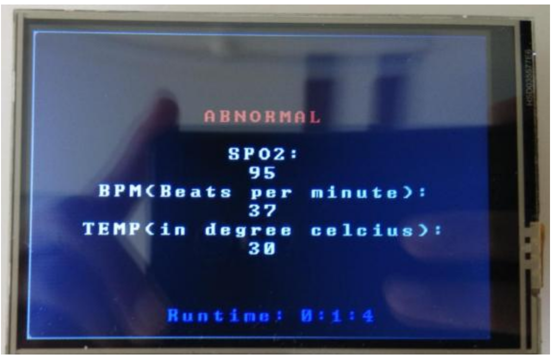

Fig. 13. Under Abnormal Conditions.

V. CONCLUSION

Robotization in each sphere of biomedical instrumentation has been created by Current Innovations. Observing modules utilizing various sensors within the Automatic Anesthesia Regularization System controls drug infusion relying on the patient's body state. At regular intervals, every one of the parameters was detected by the sensors to test the patient's condition, which was checked and insinuated within the TFT LCD whether "NORMAL" or on the other hand "ABNORMAL". This method is pre-programmed and quite helpful to the doctors who are treating the patients. This procedure is extremely beneficial to anesthesiologists who are responsible for monitoring the patient's true parameters and administering anesthesia. There is a saying as "Prevention is better than cure but protection is intelligent than prevention and cure". For upcoming execution, this module can be linked to the anesthetic ventilator. For substantial operations, they can also interact with EEG parameters. An anesthesia machine is a productive securing framework that is valuable for the surgical site. Which is utilized for Significant operation of the patient furthermore, it is very solace for the specialist who offered treatment to the patient, as it is a very chap machine utilized in commercial operation and also it is completely automated.

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